EFFECT OF BURNING UPON THE ACCUMULATION OF ORGANIC MATTER IN FOREST SOILS

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The utilization of the land resources of the United States is being placed on a more scientific and logical basis than ever before. This is not only a result of the economic conditions facing the country at present but is also due to a rapid and more extensive development of the investigation of those factors underlying the utilization of the land. The possible utilization of thousands of acres of the poorer sand lands in the southeastern coastal plains has focused attention on reforestation and the possible revenues to be obtained by following a system of logical and protected reforestation.

One of the greatest problems in the utilization of these poorer lands, however, has been the burning of forests and cut-over lands. The forestry service has been emphasizing for many years the injury to tree growth and to the possible future value of the timber, resulting from burning.

The protection of the forests and cut-over lands would allow organic residues to accumulate in the soil, and the subsequent effect of such an accumulation on the growth of the timber as well as on the possible future utilization of the land for cultivated crops has been suggested as very desirable. The organic matter problem is of great importance in the southeastern states where the temperature and rainfall, combined with the physical characteristics of the coastal plain soils, are favorable for an accelerated depletion of soil organic matter.

It is difficult to find a tract of land on the Florida peninsula which has not been burned over yearly for a number of years. The free range has led to a condition which predicates almost yearly burning of the cut-over lands in an effort to produce sufficient grass to maintain the range cattle. However, an island was located off Fernandina, Florida, on which the cut-over land and forest have not been burned for the past 42 years. The soil here is a Norfolk medium fine sand (deep phase).[2] For the purpose of comparing this soil with the soil of a burned area, a similar type of soil on the mainland near Gainesville, was sampled. This land has been burned over almost yearly for the past 42

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[2] Samples of soil were collected from the island through the courtesy of Mr. B. F. Williamson, president of the Florida Forestry Association.

years. The land on the island had a stand of virgin pine. The timber from the mainland soil had been removed within the past three years and the land left uncultivated. A fairly comparable soil condition in the two areas was prevalent during the 42 years, save for the burning factor.

Samples of soil were removed from both areas to a depth of 45 inches in the following layers: Leaf mold (present only on the island soil), 0-9 inches, 9–21 inches, 21–33 inches, 33–45 inches. A heavy leaf mold was present on the island soil but the mainland soil had only a growth of inferior range grasses.

TABLE 1

Analyses of forest soils from burned and unburned areas

Virgin Pine Forest—Norfolk Medium Fine Sand (deep phase)

DEPTH	MATERIAL*	ISLAND SOIL—UNBURNED AREA					MAINLAND SOIL—BURNED AREA				
		Organic matter	N	pH	Replaceable CaO	Hygroscopic H_2O	Organic matter	N	pH	Replaceable CaO	Hygroscopic H_2O
inches	*gm.*	*per cent*	*per cent*		*per cent*	*per cent*	*per cent*	*per cent*		*per cent*	*per cent*
Leaf Mold 4 in.	920 p. needle	96.20	0.600								
	415 intern.	93.33	0.700								
	2180 1 mold	58.87	0.715								
0– 9		2.542	0.042	5.10	0.0204	1.248	1.350	0.025	5.67	0.0300	0.553
9–21		1.336	0.021	5.50	0.0280	0.691	0.610	0.015	5.75	0.0215	0.418
21–33		0.967	0.014	5.84	0.0317	0.534	0.449	0.014	5.95	0.0181	0.233
33–45		0.607	0.015	6.10	0.0249	0.391	0.369	0.012	5.67	0.0190	0.179

Leaf mold and organic matter in leaf mold per square yard

	Leaf mold *pounds*	Organic matter *pounds*
Needles	2.03	1.95
Intermediate	0.92	0.85
True leaf mold	4.81	2.83

* Per square yard.

The soils were removed to the laboratory and carefully air-dried and mixed. The analyses included determinations of loss on ignition, total nitrogen, pH, exchangeable CaO, and hydroscopic moisture. The results of these determinations are given in table 1. Calculations of the organic matter and the nitrogen, in pounds to the acre, were made and are given graphically in figure 1.

From these analyses it appears that the protection of the forests on the island has lead to the conservation of the organic matter and nitrogen in this soil. A total loss of 121,289 pounds of organic matter to the acre by burning is shown. Calculated on the basis of 42 years that the island soils have been

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FIG. 1. NITRO

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protected, this amounts to an annual loss of 2,888 pounds an acre. A total loss of 1,126 pounds, or an annual loss of 27 pounds of nitrogen to the acre is indicated. It cannot be doubted that the burning depletes markedly not only

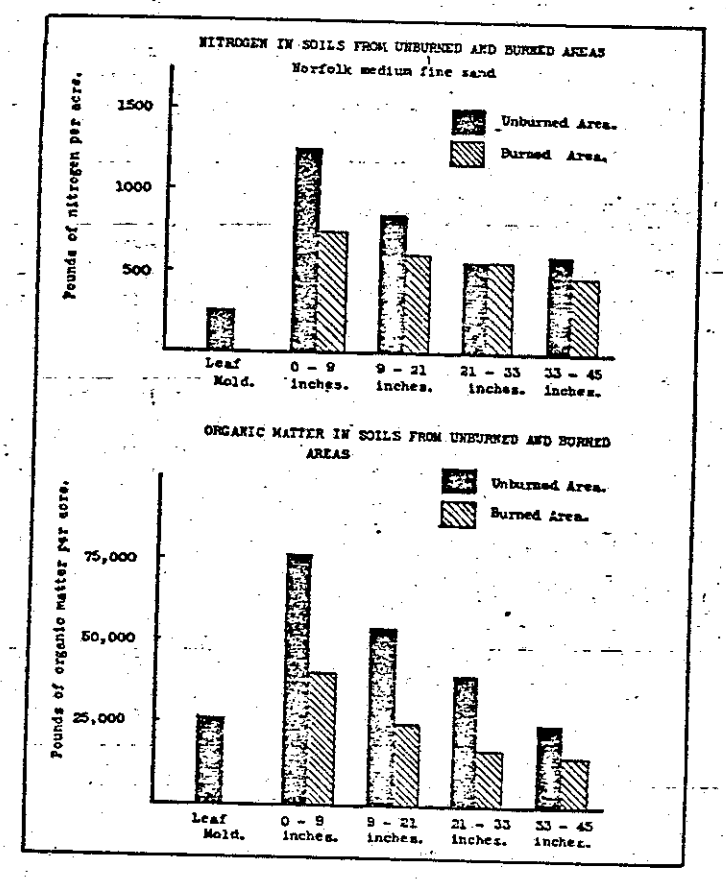

FIG. 1. NITROGEN AND ORGANIC MATTER FROM BURNED AND UNBURNED AREAS OF NORFOLK MEDIUM FINE LAND

the potential supply of the plant nutrients to the growing timber, but also that it destroys the potential organic matter supply of the soil.

There is a difference not only in the organic matter and nitrogen contents of these soils, but also in the exchangeable lime and in the hygroscopic moisture

content. These differences are no doubt associated with the differences in the organic matter content. Only in the 0–9 inch depth of soil did the replaceable lime content of the burned over land exceed that of the unburned land. This higher content of replaceable lime in the surface soil of the burned area is no doubt due to the accumulation of the ash constituents in the surface soil.

Table 2 gives the calculated percentages of nitrogen in the actual organic matter of the two soils. The percentage of nitrogen in the organic matter of the soil removed from the burned area is higher than that in the unburned

TABLE 2

Percentages of nitrogen in the organic matter of forest soils from unburned and burned areas

MATERIAL	NITROGEN IN ORGANIC MATTER	
	Unburned area	Burned area
	per cent	*per cent*
Pine needles	0.623	
Intermediate leaf mold	0.750	
Leaf mold	1.214	
0– 9 inch depth	1.652	1.852
9–21 inch depth	1.573	2.459
21–33 inch depth	1.447	3.118
33–45 inch depth	2.471	3.252

area. This indicates a more advanced stage of decomposition and failure to renew significantly the organic matter supply in the burned soils. The gradual increase in the percentage of nitrogen in the pine needles with their decomposition is correlated with the depth and evidently the age of the decomposing residues. The importance of the pine as a means of increasing the organic matter supply and the ultimate fertility of these deep phases of the Norfolk sands cannot be overemphasized, and the effects of burning over these lands distinctly interferes with the accumulation of organic matter in the soil.